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Emerging Illness and Bioterrorism: Implications for Public Health

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ABSTRACT *Biological weapons have the potential to inflict deliberate, potentially devastating epidemics of infectious disease on populations. The science and technology exist to create deliberate outbreaks of human disease, as well as disease among plants and animals, crops, and livestock. A new awareness among policymakers of the link between public health and national security requires the attention of public health professionals. The issues posed by biological weapons are likely to challenge the political assumptions of many progressive public health professionals and will demand new coalitions. The prospect of bioterrorism may offer new opportunities for improving the public health infrastructure and its capabilities.*

The US Commission on National Security for the 21st Century, cochaired by former Senators Warren Rudman and Gary Hart, was appointed by President Clinton and Congress to make recommendations about emerging national security threats facing the nation. The commission report emphasized the importance of bioweapons as a strategic threat and cited an attack using bioengineered pathogens as one of the chief dangers facing the country.[1] Such an attack could conceivably kill millions and disrupt democratic processes. The Commission concluded, in part, that

> To deal medically and psychologically with potentially large losses of American lives in attacks against the American homeland, US public health capabilities need to be augmented. In addition, programs to ensure the continuity of constitutional government should be bolstered.[1(p9)]

THE THREAT

Bioweapons constitute a significant threat to US national security. First, they have destructive power capable of killing entire populations. In 1993, the Congressional Office of Technology Assessment estimated that 100 kg of anthrax released upwind of a city could cause up to 3 million deaths, depending on wind conditions and other variables.[2] This lethality is comparable to that of the hydrogen bomb. Admiral Stansfield Turner has noted that biological weapons and nuclear weapons are the only weapons classes with the capacity to bring the United States past the "point of non-recovery."[3]

Bioweapons are important because the knowledge and materials needed to build them are widely accessible. Iraq admitted to manufacturing 8,000 L of an-

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thrax solution; the United Nations believes the actual amount may be as much as 10 times that quantity. The amount of concentrated anthrax solution held by a single fermenter found in Iraq, 1,500 L, contains about 100,000 lethal doses per millimeter. Iraq's bioweapons program also produced botulinum toxin, alpha toxin, and a mold that could wipe out wheat crops.[4] The equipment needed to create these weapons has many legitimate uses and can be purchased on the open market.

A sophisticated technological base or a massive industrial infrastructure is not required to build biological weapons. The necessary equipment is easily transported and easily hidden, unlike the infrastructure required to produce nuclear weapons. Nuclear facilities require specialized materials and technology and are hard to hide. When the first uranium enrichment plant—one of the several large industrial enterprises necessary to create nuclear weapons—was built in 1944, it was the largest roofed structure in the world.[4] The "dual-use" nature of biotechnology makes production of bioweapons more feasible and more difficult to detect.

Not until the early 1990s did the West learn that the Soviet Union had been pursuing a massive offensive bioweapons program for decades. Biopreparat, as the civilian bioweapons effort was called, had employed over 30,000 people at its peak, ostensibly for the purpose of biomedical research and development. The military operated a separate program, and another branch of the Soviet effort focused on weapons against agricultural crops.[5] The accomplishments of the Soviet bioweapons empire include the manipulation of viruses and microorganisms to render them capable of surviving delivery on missile warheads; the development of antibiotic-resistant strains of plague; research into peptides that can alter mood and heart rhythms; and the manufacture of tons of anthrax, smallpox, plague, and other pathogens.[5] Concerns continue about the fate of the cell lines, production "recipes," and knowledge that were part of Biopreparat. Many of the scientists who worked in the Soviet bioweapons program are now unemployed, and some have been approached by Iran and other countries interested in building offensive programs.[6]

Bioweapons also have the potential to overcome American military superiority in conventional military forces. Sometimes referred to as the "poor man's atomic bomb," bioweapons offer an inexpensive means of "asymmetric warfare" that could be employed effectively, and possibly with impunity, against the United States or other powers that possess superior conventional forces.[7] The Central Intelligence Agency estimates that at least 12 countries possess or are actively seeking an offensive bioweapons capacity.[8]

Finally, bioweapons represent an important national security threat because of the growing power of biological science. As our understanding of molecular biology increases and the ability to manipulate cellular processes expands, we will inevitably create the tools to build new and more powerful biological weapons. Both the diversity and the potency of bioweapons will grow as biological knowledge expands, and this expansion is happening at a prodigious pace.

NEW QUESTIONS

The age of "big biology" that we are now entering holds the potential for fantastic benefits for disease prevention and cures and the protection of vital ecosystems. The expansion of the life sciences is being driven by formidable market forces, backed by worldwide industries in the fields of pharmaceuticals and biotechnology.[9] An attempt to halt the evolution of the life sciences would be futile and fool-

ish, yet the future will inevitably produce difficult dilemmas for scientists and policymakers. Should all biological discoveries be published in the open literature? Should any biological knowledge with particular relevance to weapons production be somehow constrained? What is the individual researcher's role and responsibility in preventing the development and use of biological weapons?

The consequence of a biological weapons attack would be an epidemic of infectious illness. The most likely and most destructive scenario would be a covert, unannounced attack. There would be no explosion or obvious event; we would only know something had happened when large numbers of people began to die or appeared in emergency rooms or doctors' offices with unexplained illnesses. Depending on the biological agent and its incubation period, this could be days (anthrax) or weeks (smallpox) after the weapons' release. By the time it would be recognized, the epidemic could already have spread to other regions or countries.[10,11]

American physicians are not trained to diagnose anthrax, smallpox, or plague. Most have never seen a single case and would not ordinarily consider these diseases in their differential diagnoses. Recognition that an outbreak was under way would also be complicated because the initial symptoms of many bioweapons agents resemble common illnesses. Further, reliable laboratory tests that could quickly identify many bioweapons pathogens are available only in specialized facilities.

MANAGING THE THREAT

There are many reasons beyond bioterrorism to worry about our ability to manage outbreaks of infectious disease.[12] Population pressures and globalization have enhanced the conditions needed for swift spread of infectious illnesses, and increasing urbanization and megacities housing millions of people create nearly ideal conditions for the cultivation of pathogens. These conditions include inadequate sewerage and clean water, poor nutrition, and circumstances that place humans and animals in close proximity.

Intrusion into once-remote ecosystems also presents opportunities for human encounters with previously unknown viruses and bacteria. International travel and commerce provide the means to spread disease throughout the globe in a matter of hours. The globalization of the food supply has created vast networks of food distribution that make it hard to track or control contamination. Investing in our ability to manage infectious disease epidemics could serve both public health and bioterrorism management.

The United States is poorly prepared to respond to epidemics. The hospital and health care delivery system has little capacity to deal with sudden increases in patient demand. Recent financial pressures on hospitals have resulted in cutbacks and efficiency measures that have effectively eliminated any "surge" capacity.[13] Few vaccines or medicines are effective against the bioweapons pathogens of greatest concern. When efficacious vaccines do exist (e.g., for smallpox), existing supplies are extremely limited.[14]

Public response to a deliberate epidemic will have profound repercussions, including the potential to place limitations on civil liberties in efforts to stem the epidemic. The means have not been developed for rapid communication with decision makers, the public, and the media to convey persuasively what might be done to protect oneself and others against contagion. A bioterrorist attack on American soil—especially if the disease is contagious and fatal—will cause anxiety and possibly panic. People will expect a coherent and effective response. If the government

and key organizations such as hospitals do not respond quickly and convincingly, worries will grow. Mass exodus from large cities and disruption of travel and trade will occur, and citizens may lose confidence in government institutions.

PUBLIC HEALTH INFRASTRUCTURE

The ability of federal, state, and local public health agencies to fight deliberate epidemics needs to be improved significantly. Public health response to a bioterrorist attack would include many discrete functions, including epidemiological detection and investigation of the outbreak; laboratory diagnosis; provision and dissemination of treatment recommendations; coordination of health care services in a community; communication with the public; and the linking of local, state, and federal health resources and response efforts.

It is important to understand that, for the first 24 to 48 hours of the epidemic, response to a bioweapons attack would be totally dependent on local resources.[15] It would take at least that long to mobilize and deliver federal assistance to the affected area. Furthermore, all federal response plans assume the federal government will be supporting local authorities. Federal officials would not "ride to the rescue." For one thing, the federal government does not possess the resources to take over from counties and cities. During a recent exercise (known as TOPOFF) designed to test the ability of federal authorities to respond to a simulated plague attack on Denver, Colorado, the federal Centers for Disease Control and Prevention (CDC) essentially exhausted its epidemiological resources in responding to Denver's needs. As the epidemic spread to other states, no additional CDC personnel were available to assist local health departments in the field.[16]

Epidemiological analysis will be critical in determining the scope of the attack, identifying the source of the exposure, and tracking the course of the epidemic and the efficacy of intervention measures. It is unlikely that, in the near future, electronic epidemiologic surveillance systems monitored by public health epidemiologists will detect the first signs of a bioweapons attack. It is far more likely that clinicians will be the first to suspect that something unusual is happening. It is essential that clinicians notify public health professionals of their suspicions, and that public health agencies are staffed with knowledgeable individuals who have the training and resources to respond quickly and appropriately to clinicians' reports and who are available 24 hours a day.

The pace of the epidemiological inquiries surrounding a bioweapons attack will need to be much brisker than that characterizing most natural disease outbreaks. During the TOPOFF exercise, participants found that the traditional mode of public health decision making that relies on discussion and consensus was too slow and too confusing to respond effectively to a fast-moving, lethal epidemic.[16]

During a "deliberate epidemic" public health agencies will be called on to coordinate health care services in a city or region. The US health care system is highly fragmented and competitive. Health care facilities and hospitals are not accustomed to working collaboratively or sharing resources. Public health professionals may be needed to act as the "glue" in the epidemic response, ensuring that information flows between institutions and that available resources are managed efficiently. For example, the usefulness of the National Pharmaceutical Stockpile of the CDC will depend, in large measure, on local plans and capabilities for distributing the stockpiled pharmaceuticals and materials. During TOPOFF, breaking down the massive packages of equipment and medicines and getting stockpile supplies to the hospitals

and clinics that needed them proved a major problem for local authorities.[16] For these reasons, we must ensure that public health and medical service providers are at the decision-makers' table at all levels of government during bioterrorism planning and response.

OPPORTUNITIES

The threat of bioterrorism is elevating traditional public health missions, such as epidemic response and management of disease outbreaks, to the status of a high national security priority. This new priority presents political opportunities to improve the visibility, funding, and efficiency of public health. But we must use this opportunity wisely and choose prudent goals. Although a multitude of public health tasks are arguably pertinent to responding to a deliberate epidemic, we should identify critical public health capacities that are essential to epidemic response and concentrate on improving these essential functions. Essential improvements needed in the public health infrastructure include the following:

- *Better information flows from health care systems to public health agencies.* It is especially important to strengthen and nurture the link between medical providers and public health agencies. Such a link is an essential component of any effective disease tracking system.
- *Faster outbreak analysis tools.* The lack of computers and electronic data systems available to public health officials at the state and local levels must be remedied.
- *Public health surge capacity.* Provisions must be made to rapidly expand the personnel available to health departments during emergencies. Use of university-based experts and professionals from other health-related fields should be considered.

We should actively seek to build public health systems and programs that serve routine organizational purposes. Such dual-use systems are more cost-effective than specialized systems and are more politically feasible. Moreover, systems used only in rare emergencies are unlikely to perform well in the midst of crisis.

We cannot create the necessary public health systems overnight, nor can we create them inexpensively. It is important that we adopt strategies that are sustainable over a period of years. Politicians and other leaders are better able to maintain funding support for projects if clear and measurable outcomes are achieved over short time frames. This argues for an incremental approach to system building, with measurable milestones and outcomes assigned to large projects so that we can convincingly demonstrate progress toward a clear goal. We also need to develop realistic cost estimates of what is proposed. How much would it cost to create a state-of-the-art, electronic-based public health surveillance system for a large city? Would such an investment be a good use of resources? These are the type of questions that must be asked and answered if public health professionals hope to persuade elected officials to fund upgrades in the public health infrastructure.

In the last fiscal year, the federal government spent about $1.4 billion on countering chemical and biological terrorism. The Department of Health and Human Services received less than 2% of this total, even though the core of any meaningful response to bioterrist attack must be based on public health principles and activities. In the past year, Congress allocated $250 million to the CDC to improve

bioterrorism preparedness. Approximately $50 million of these funds were distributed as grants to state health departments with the intent to improve state and local capacities to respond to deliberate epidemics.[17] This may seem like a large sum of money in public health terms, but it is not much when viewed against the $260 billion Department of Defense budget or in light of the significance of the national security threat posed by biological weapons.

One of the challenges of the coming years will be to invest funds in biodefense that are commensurate with the threat and to do so in ways that actually improve our ability to prevent and, if necessary, respond to a biological weapons attack. The Public Health Threats and Emergencies Act, cosponsored by Senators Frist and Kennedy and signed by President Clinton, was a useful and responsible start. The Frist-Kennedy Bill authorized the Department of Health and Human Services to spend up to $500 million to improve the nation's public health infrastructure and address issues related to antibiotic resistance.[18] Unfortunately, Congress did not appropriate funds for this initiative—a failing that the next Congress should be urged to correct.

Biological weapons represent a new hybrid of national security threat and public health emergency. As we enter the new millennium, it is discouraging to consider that the thinly spread forces of public health must confront the potential of a biological weapons attack against civilian populations. Yet, preventing and possibly mitigating the consequences of deliberate epidemics are clearly among the responsibilities that must be shouldered by the public health and medical communities of the 21st century.

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